

US EPA ARCHIVE DOCUMENT

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Costs and Benefits of Water Quality Protection

Introduction

Section 305(b) of the Clean Water Act calls for states to prepare estimates of the economic and social costs and benefits necessary to achieve the goals of the Act. The goals that states focus on are that all waters are fishable and swimmable. This means that water quality is good enough to support a balanced population of shellfish, fish, and wildlife and allow recreational activities in and on the water. Because states develop water quality standards to support these and other beneficial uses, they generally consider the costs and benefits of meeting water quality standards when they evaluate the costs and benefits of achieving the goals of the Act.

Unfortunately, this is a very daunting task. It may seem fairly easy to count the amount of money spent on pollution control by the public and private sector, but these data can be difficult to obtain.

Measuring benefits poses a more complex challenge. First, benefits are realized by a wide variety of users, ranging from commercial fishing operations to individuals who want to know that the environment passed on to their grandchildren will be healthy. Second, it is easier to describe benefits than it is to put a dollar value on them because many types

of benefits do not involve market transactions. Many argue that it is not appropriate to try to put a dollar value on all of the benefits of a clean environment.

Ultimately, implementation of the CWA takes place at a very local level, and the costs and benefits of cleaner water are realized initially at the local level. For example, improvements in water resource quality usually result from investment of time and money to address a specific problem or combination of problems in a specific area. Therefore, changes in the quality of water resources, such as reductions in levels of pollutants or improvements in aquatic habitat, occur in fairly localized areas. These localized improvements in the quality of water resources result in changes in the structure and function of local aquatic communities, including populations of fish and wildlife. The ways in which people value water quality improvements reflect their beliefs and priorities. Consequently, implementation costs, the resulting changes in the condition of the waters, and the resulting benefits are best generated beginning at the watershed level and aggregating up to the state and national level.

Unfortunately, neither the data nor analytic tools and expertise are available to comprehensively build and estimate the costs and benefits of achieving the goals of the Act

from the watershed up to the nation. Efforts to estimate the economic and social costs of achieving the goals of the Act are hindered by a number of factors. The primary factors are:

- Limitations of analytic tools to characterize costs and benefits
- Insufficient data on water quality conditions and trends and links to benefits
- Insufficient data on resource needs to fully meet the goals of the Act.

The inadequacy of environmental data leads, in turn, to enormous difficulties in estimating the nationwide economic and social effects of attaining the CWA's goals. The lack of watershed-level data on water-body conditions and trends makes the estimation of the resulting economic and social effects at the local level extremely difficult as well as incomplete.

To provide some sense of an overall national picture of past and future effects of the CWA, absent the information needed to build the picture from the bottom up, EPA has drawn upon the very limited number of national reports and databases relevant to this topic. Sources of such information include the U.S. Department of Commerce, Bureau of Census, the Sport Fishing Institute, state reports, EPA, and other federal sources. Though unable to form the basis for a precise estimate of nationwide

effects of the CWA, these studies do provide a useful framework that gives some sense of the magnitude of these impacts. Some of these studies express data in terms of economic measures, while others use different quantitative measures from fields such as sociology and political science. Still other relevant reports express information in qualitative terms, including national public opinion surveys. The first part of this chapter presents this overview information.

The nationwide picture presented in this chapter is supplemented by another section that contains information based on data in the 1998 305(b) reports submitted by the District of Columbia, Puerto Rico, and the following states: Arizona, Hawaii, Illinois, Indiana, Louisiana, Maryland, Massachusetts, Michigan, New Hampshire, North Dakota, Oregon, Rhode Island, South Dakota, Utah, Vermont, Virginia, and Wyoming. Because they are easier to calculate, estimates of the economic costs of selected activities to improve water quality are more common in these reports. Estimates of the economic and social benefits resulting from improved water quality are more difficult to quantify. Hence, state reports, and this national report from EPA, also include qualitative descriptions of benefits and quantitative results from small-scale studies of the benefits of water quality restoration. The second part of this chapter presents this state-by-state information.

Costs and Benefits of Water Quality Improvement

Costs of Water Quality Improvement

Estimates for the most current available year (1994) of the costs of implementing water quality control programs called for in the Clean Water Act are shown in Table 9-1. This information was derived from President Clinton's *Clean Water Act Initiative: Analysis of Costs and Benefits*. This table shows expenditures associated with the implementation of the Clean Water Act requirements. It includes implementation of all aspects of the cycle for water-quality-based pollution control:

- Development of water quality standards
- Assessment of water quality
- Characterization of causes and sources of impairment
- Development of point and non-point source loading allocations to achieve the water quality standard
- Implementation of source controls
- Evaluation of the effectiveness of controls
- Followup actions and reiteration of the cycle to ensure all waters meet water quality standards.

According to this report, private sources spend roughly \$30 billion per year on water pollution control.

Table 9-1. Summary of 1994 Current and Planned Spending under the Existing CWA (\$ million/year)^a

Description	Private Sources	Municipalities	Agriculture	State Water Programs	Federal Agencies	Total (Quantified)
Pre-1987 CWA base programs WQS TMDL Monitoring NPDES	\$25,286	\$17,190	\$191	\$373	\$9,564	\$52,604
Post-1987 CWA additional programs NPS Controls/ Watershed		\$389 - \$591	\$240 - \$389	\$125	\$234	\$988 - \$1,339
Storm Water: Phase I	\$3,990	\$1,650 - \$2,555				\$5,640 - \$6,545
CSOs		\$3,450				\$3,450
Other Costs	\$943 - \$1,073	\$88				\$1,031 - \$1,161
Total	\$30,219 - \$30,349	\$22,767 - \$23,874	\$431 - \$580	\$498	\$9,798	\$63,713 - \$65,099

^aThe values shown here are only for administering the plan.

Source: U.S. EPA. 1994. *President Clinton's Clean Water Act Initiative: Analysis of Costs and Benefits*. EPA 800-S-94-001. Office of Water, Washington, DC.

In addition, municipalities spend \$23 billion per year and agriculture approximately \$500 million per year. Federal agencies dedicate an estimated \$10 billion and state water programs \$500 million to water resource protection each year. In total, there is an estimated expenditure of \$63 billion to \$65 billion per year to protect and restore water quality nationwide.

Benefits of Water Quality Improvement

Improvements in the physical, chemical, and biological quality of our nation's waters are valuable to all Americans. The benefits of achieving the objectives of the Clean Water Act are, and will be, manifest in a variety of ways including

- Increased recreational choices
- New and expanded business opportunities
- Improved property values
- Expanded educational and research options
- Greater peace of mind regarding the condition of the natural heritage we pass on to future generations.

Activities such as fishing, swimming, and boating on waters would not be adequately safe or sufficiently satisfying without the control measures undertaken under the Clean Water Act. Cleaner water lowers treatment costs to agriculture and to industries by avoiding pretreatment costs before usage of these waters. It also reduces costs to drinking water systems that might otherwise have to install additional

treatment technologies. Cleaner waters also provide important aesthetic benefits to Americans.

Although it is relatively easy to list the various categories of health, social, psychological, and economic benefits to current and future generations, it is extremely difficult to estimate the magnitude of such benefits. Still, there are a number of sources of data that provide some indication of the scale of such benefits. The following section presents a sampling of such information.

Recreation

Water-based recreational activity makes a large contribution to America's economy. A 1994 Roper Survey found that beaches, rivers, and lakes are Americans' top vacation choices, followed by national and state parks, many of which are centered on natural water features. Overall, Americans take over 1.8 billion trips to engage in one or more forms of water-based recreation. Given that the recreation and tourism industry in the United States enjoys sales of over \$400 billion annually, economic activity associated with highly popular water-based recreation is clearly quite large.

According to the 1994 National Survey on Recreation and the Environment (NSRE), sponsored by the U.S. Forest Service, National Oceanic and Atmospheric Administration, and other agencies and organizations, 125 million Americans over age 15 visited a beach or waterside area—62% of those in this age group. An estimated 78 million swam in a river, lake, or ocean—an increase of 38% since 1982. Water-based nature study was enjoyed by 55 million Americans, representing 28% of the population

over age 15. Remarkably, 27 million people participated in some form of viewing fish and other aquatic life.

All this recreational activity generates, of course, a tremendous amount of economic activity. For example, anglers spent \$15 billion in 1996 for fishing trips, \$19 billion on equipment, and \$3.2 billion for licenses, permits, and other miscellaneous expenses, according to the 1996 National Survey of Fishing, Hunting and Wildlife-Associated Recreation conducted by the U.S. Fish and Wildlife Service (FWS). Expenditures for equipment related to wildlife watching, much of which is focused upon aquatic and riparian species, increased by 21% since 1991. According to this study, the total impact of fishing-, hunting-, and wildlife-associated recreation in 1996 was \$101 billion. Though not all of this can be attributed directly to healthy waterbodies, all species of animals and plants depend upon adequate supplies of clean water.

There are indications that a significant portion of the public thinks that their enjoyment of water-based recreation is restricted by poor water quality. For example, the 1994 NSRE found that 10% to 20% of various sectors of the public felt that pollution problems constrained their outdoor recreation activities. Actions taken to restore impaired waters and protect the integrity of currently healthy waters should lead to a smaller proportion of these sectors of the public feeling that their outdoor recreational experience has been compromised, thereby increasing total overall benefits to the nation.

The 1997 FWS Survey also found that 20% to 25% of persons characterized as “nature lovers,”

hunters, and fishers felt the quality of their outdoor recreation experience was constrained by “crowded activity areas.” It is likely that, as more waterbodies are restored to healthy conditions, recreational use will be less concentrated on those waterbodies that are currently healthy. This will result in less crowding, on average, thereby providing benefits in the form of improved quality of recreational experience to a sizable fraction of the total population.

Commercial Fishing

The National Marine Fisheries Service report on U.S. coastal and offshore fisheries reported that the value of U.S. commercial fish landings was about \$3.1 billion in 1998. Shellfish landings represented slightly more than half of this total. Over 80% of the value of U.S. finfish landings was from species that are dependent on near-coastal waters for breeding and spawning. At the time of the 1998 report, the U.S. commercial fishing fleet included nearly 75,000 vessels. Almost 5,000



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processing and wholesale plants employed over 83,000 people in 1997.

Yet, the contribution of the commercial fishing sector to the overall economy potentially could be increased if, through cleanup of key coastal waters, thousands and thousands of acres of shellfish beds that are currently closed or restricted due to pollution could be reopened to commerce.

Other Water Quality Benefits to the Economy

Other highly important sectors of the American economy are dependent upon supplies of good-quality water. In 1995, the USGS estimated that manufacturing companies used more than 9 trillion gallons of fresh water each year. According to the 1997 Census of Agriculture, the agricultural sector, which produced \$197 billion worth of products in 1997, is increasingly dependent on irrigation of crops, drawing upon both surface and ground water supplies. The \$100 billion/year soft drink and beer industries are highly dependent on supplies of high-quality water.

Good water quality is important for local economic development. Companies that want to attract the best workers often locate in areas noted for parks and open spaces, where air and water quality are good and recreational opportunities are abundant. These amenities are essential for the quality of life required by today's workforce.

The Institute for Southern Studies published a study in October 1994 illustrating the relationship between state economic growth and environmental quality. This study shows that strong environmental standards and gross state products growth are positively related, although the causal relationships underlying this association have not been established. For example, the study ranked Louisiana last for jobs and environmental quality. Eight other southern states (along with Indiana, Ohio, and Oklahoma) ranked among the 14 worst states in both categories. Hawaii, Vermont, and New Hampshire ranked among the top six states for both jobs and environmental quality. Six states ranked among the top 12 in both categories: Wisconsin, Minnesota, Colorado, Oregon, Massachusetts, and Maryland.

Ecological Benefits

Restoration of impaired waters and protection of threatened waters promises to result in significant ecological benefits. Currently, a disproportionate number of aquatic and semi-aquatic species of plants and animals are endangered or threatened. According to the Nature Conservancy's document *Rivers of Life* (1998), two-thirds of the nation's species of freshwater mussels are at risk of extinction, half of all crayfish species are in jeopardy, and 40% of the species of freshwater fish and amphibians are at risk. Some of the causes of declines

in populations of these species are activities, such as overharvesting, that are unlikely to be affected by implementation of the Clean Water Act. But other factors contributing to the declining condition of a number of these species are addressed by the Act. For example, pollution is listed as a contributing factor in the decline of 30% to 90% of the species in each of four categories of water-dependent species—fish, crayfish, amphibians, and freshwater mussels.

The Nature Conservancy concluded that “protecting and restoring 327 watersheds—15% of the total (nationwide)—would conserve populations of all at-risk freshwater fish and mussel species in the United States.” This suggests that a wisely targeted strategy for implementation of the CWA for both impaired and threatened waters could significantly contribute to the protection and recovery of aquatic biodiversity in the United States.

Not only is protection and restoration of the ecological integrity of our nation’s waters deemed highly important by the scientific community, polling data indicate that protection and restoration of biodiversity enjoys strong public support. A 1996 national poll conducted by Beldon and Russonello got the following responses from a series of questions designed to understand how environmental protection fits into the priorities of U.S. citizens.

■ Compared to dealing with other issues you are concerned about,

how important is maintaining biological diversity (preventing the extinction of plants and animals)?

Very important	41%
Somewhat important	46%

■ Protecting jobs right now is more important than saving habitat for plants and animals.

Strongly disagree	19%
Somewhat disagree	45%

Even when asked about paying more in federal taxes to have the government buy land to protect endangered species and habitat, 48% agreed, and 78% supported tax incentives to encourage land owners to voluntarily protect habitats for plants and animals.

Other Indicators of the Public’s Perception of Benefits from Cleaner Water

Results of other public opinion surveys indicate that a large portion of the American public believes that there are problems with the condition of our nation’s waters. A number of national polls have shown that Americans view water pollution as one of the top two or three environmental problems in the United States. For example, the 1993 Roper poll conducted for the National Geographic Society found that 75% of Americans felt that water pollution is among the most serious environmental problems facing future generations. This same poll found that 39% say that the quality of the fresh surface waters in their

community (used for recreation, wildlife, and industry) was only “fair” or “poor.”

A 1997 poll conducted by Roper for the National Environmental Education and Training Foundation (NEETF) found that 72% of the public believed that “environmental protection laws and regulations dealing with water pollution have not gone far enough.” This contrasts with 62% of the public who felt this way about air pollution and 48% who said this about protecting wild and natural areas. Only 4% of those polled indicated they thought laws and regulations dealing with water pollution had gone too far, compared with 6% for air pollution and 7% for protecting wild or natural areas. A 1996 poll conducted by Belden and Russonello found that 64% of Americans strongly agreed with the statement, “[Clean Water Act] regulations should be maintained because water quality is worth the cost, and the regulations have had positive effects on water quality.” Conversely, only 7% strongly agreed with “We need to reduce the hundreds of regulations in the Clean Water Act because they have become too restrictive and expensive for business and private citizens.” (These findings were consistent across all key demographic groups, based on gender, races, ages, and income and educational levels.)

Regardless of whether the opinions reflected in these poll findings are based on an accurate understanding of the condition of the nation’s waters and the nature of the rules designed to protect them, these polling data do indicate that

any actual improvement in water quality is likely to be perceived as beneficial by a large portion of the populace.

The 1996 Belden and Russonello poll provides some insight into the personal values that underlie support for protection of the environment. Eighty percent (80%) of those polled cited “wanting your family to live in a healthy pleasant environment” as a reason for personally caring about the environment. Seventy one percent (71%) said “responsibility to leave the earth in good shape for future generations” was a primary reason for environmental concern. “Nature is God’s creation and humans should respect God’s work” was chosen by 67% of those polled.

The 1997 Roper poll for NEETF also found that people’s concerns about the environment were not significantly tempered when placed in contrast with economic considerations. Fully 69% of those polled replied “environmental protection” when asked, “When it is impossible to find a reasonable compromise between economic development and environmental protection, which do you usually believe is more important: economic development or environmental protection?” A 1993 Roper poll found that 76% of the people felt that upgrading municipal water treatment systems was a good or excellent idea, even if it resulted in raised local taxes. Though one can question whether these answers accurately reflect what people would actually do when confronted with such a choice, the answers do suggest that the public puts a high value on

protection of the environment and is willing to pay for such protection.

Another indicator of public concern for protection and restoration of water resources is the rapidly growing number of people involved in organized efforts on behalf of streams, lakes, marshes, bays, estuaries, and coastal waters. For example, the Adopt-Your-Watershed database currently has over 4,000 local groups that are involved in one or more types of waterbody protection and restoration efforts. In these examples, people are contributing their time and energy, perhaps as well as some of their money.

Water Quality Costs and Benefits Identified by the States

Most states reported that they encountered great difficulty in reporting on the economic and social costs and benefits of actions to achieve the goals of the Act. Most states were able to provide some estimates of expenditures on some aspects of water quality protection or restoration. Typically, this cost information included the amount of money provided through grants or loans to upgrade municipal wastewater treatment plants or the annual budget for the jurisdiction's water quality management program.

When reporting on benefits, most of the states provided limited qualitative descriptions of the types of benefits accompanying implementation of the Clean Water Act. Several states, however, conducted

cost/benefit analyses. For example, Illinois reported on a cost/benefit analysis performed for three lake restoration projects. The District of Columbia reported on the number of fishing licenses issued as an indicator of the benefits of improved water quality.

The following section highlights some of the more recent data reported by states, the District of Columbia, and Puerto Rico in their Section 305(b) water quality reports.

District of Columbia

The District of Columbia reported on the total operating costs of treating wastewater at the Blue Plains treatment plant. This is one of the largest wastewater treatment plants in the country. The plant's service area includes the District of Columbia and parts of Maryland and Virginia. Increases in costs have come mainly from aging equipment and inflation's effect on wages, equipment, and maintenance costs. The total annual operating costs in 1998 were approximately \$92.2 million. About \$20 million of the 1998 costs were due to the upgrade and operation of the biological nutrient removal process. Annual costs in 1999 are estimated at \$86.5 million.

The District offered a discussion of the qualitative improvements in water quality over the past decade. Recreational fishing is one area that has benefited from such improvements. Routine surveys conducted by the Fisheries Management Branch reveal a significant increase in the number of game

fish, including striped bass and perch. The sale of fishing licenses in the District is also an indicator of recreational use. In 1988, the District of Columbia began to require that anglers purchase a license to fish in District waters. The number of licenses sold from 1988 to 1995 increased from 4,900 to 12,695. However, in 1996 and 1997 the number of licenses sold decreased slightly to 11,028 and 10,925, respectively.

Arizona

The population of Arizona has been increasing rapidly. In 1950, the state's population was 775,000. By 1995, the population increased to an estimated 4.2 million. Most of this increase occurred in the two largest cities, Tucson and Phoenix.

This rate of population growth will require the creation of additional sources of water to cover the demand for agricultural, municipal, and industrial use. At present, 60% of the public drinking water supply in Arizona is ground water. State planners anticipate that the use of effluent and surface water sources will need to increase to satisfy the increasing demand for water. The goal is to provide inexpensive, high-quality water supply to serve a variety of users. For this to happen, the state needs to increase its efforts in protecting and remediating both surface and ground water sources.

Arizona designates all ground water aquifers for drinking water use. The goal of the Aquifer Protection Permit Program is to prevent pollution of Arizona's ground water by controlling discharges from wastewater treatment facilities, industrial sources, and mining operations. In 1997, the program spent over \$2 million and targeted nitrogen reduction in discharges that impact ground water supplies. Nitrogen poses a serious health risk in drinking water, particularly to infants. Arizona's program resulted in the removal of 12,179 tons of nitrogen in 1997.

The annual expenditures of the state's water quality programs provide an estimate of the costs to maintain water quality programs during the years 1994 through 1997. Table 9-2 shows this information.

Table 9-2. Arizona's Water Pollution Control Costs

Program Name	FY 1994	FY 1995	FY 1996	FY 1997
Water Quality Program Management	\$1,615,300	\$1,463,800	\$2,194,500	\$1,805,500
Safe Drinking Water	\$1,489,800	\$1,704,800	\$1,780,200	\$1,789,800
Water Quality Assessment and Monitoring	\$2,177,200	\$7,031,700	\$1,728,600	\$1,943,500
Point Source Discharge	\$3,128,400	\$2,877,800	\$2,670,000	\$2,312,100
Nonpoint Source Discharge	\$1,344,000	\$1,770,700	\$1,801,800	\$1,386,800
Public Health Safety		\$104,400		
Underground Storage Tanks Program	\$16,778,700	\$23,836,200	\$36,088,700	\$32,187,900
Superfund Program	\$2,102,200	\$3,395,500	\$4,142,600	\$3,566,700
Total Water Pollution Control Programs	\$28,635,600	\$42,185,000	\$50,415,200	\$44,992,300

Hawaii

Hawaii's 305(b) report estimated that, since 1995, Honolulu County has spent \$279 million on wastewater and public works projects; Maui County has spent \$82 million on sewer operations, flood control, and drainage; and Kauai County has spent \$7 million on stormwater control and sewage treatment. Although the state's report did not provide detailed information on monetized benefits, the state noted that water quality improvements increase the economic well-being of the population. Benefits include improved recreational opportunities, aesthetics, and commercial fishing opportunities.

Illinois

Illinois' 305(b) report stresses the fact that collecting information on costs and benefits related to the achievement of the objectives of the Clean Water Act was a complex task, and the tools and information needed are not readily available.

The state reported the individual program costs of pollution control activities in the state of Illinois for the year 1996 (Table 9-3). In addition to these costs, the Bureau of Water distributed a total of \$18.2 million in state construction grants and an additional \$66.6 million in

loans for the construction of municipal wastewater treatment facilities.

The Illinois Bureau of Water prepared a cost/benefit analysis of efforts to restore water quality in three inland lakes. By comparing pre- and post-restoration water quality conditions in the lakes, annual benefits were calculated based on potential increases in "visitor days" estimates. The results are shown in Table 9-4.

Indiana

Since July 1, 1997, more than 30 communities in Indiana have obtained loans of over \$174 million for water quality improvements through the State Revolving Loan Fund (SRF) Program. One of these

Table 9-3. Program Costs for Illinois Environmental Protection Agency's Bureau of Water

Activity	Total
Monitoring	\$3,928,700
Permitting	\$2,785,800
Planning	\$1,292,600
Compliance/Enforcement	\$3,596,600
Facilities Administration	\$2,039,700
Lake Protection and Restoration	\$754,100
Nonpoint Source Control	\$2,610,200
Ground Water Protection	\$1,804,500
Total	\$18,812,200

Table 9-4. Summary of Cost/Benefit Analysis for Lakes Restoration Projects in Illinois

Lake Name	County	Increase in Annual Benefits Post-Implementation	Total Discounted Benefit 10 Years @ 7-1/8%	Restoration Activities	Benefits to Costs (in dollars earned to dollars spent)
Le-Aqua-Na	Stephenson	\$660,700	\$4,614,000	\$262,918	17.5:1
Johnson Sauk Trail Lake	Henry	\$487,630	\$3,405,500	\$131,000	26.0:1
Lake of Woods	Champaign	\$197,060	\$1,376,000	\$256,434	5.4:1

loans included a \$2 million drinking water project.

Indiana's 305(b) report notes that improvements in water quality result in better recreational opportunities, more aquatic diversity, healthier sport fish populations, safer drinking water, increased use of beaches, and healthier aquatic ecosystems. The Office of Water Management in Indiana did not quantify these benefits. However, through the Performance Partnership Agreement with EPA they expect to have the necessary resources to quantify the significant benefits of water pollution abatement.

Louisiana

Louisiana spent approximately \$8.5 million in FY 1995 and \$13.4 million in FY 1996 to protect the state's water resources. While much of this budget was self-generated through permit fees and enforcement actions, a portion was derived through federal grants.

Louisiana's 305(b) report estimates that, from 1992 to 1994, the state's economy benefited from water quality improvements of approximately \$1.6 billion. These benefits are associated with commercial and recreational fishing (\$1 billion) and hunting and non-consumptive uses (\$656 million). Although hunting and non-consumptive wildlife activities are not directly associated with water quality, terrestrial wildlife and especially waterfowl are dependent on the availability of high-quality waters. In addition to these direct monetary benefits, visitors to Louisiana have an additional impact on many local economies. Although all outdoor recreation may not be water-based,

it can be assumed that water quality is a factor in the overall environmental perception of travelers.

Michigan

Since 1972, Michigan has spent about \$4 billion on about 1,100 municipal wastewater treatment plant improvement projects. The state estimates that \$900 million is needed to meet federal and state requirements for municipal wastewater treatment and an additional \$1.9 billion is needed to meet optimal conditions that reflect water quality enhancement, growth capacity, and economic development. In addition, the state estimates costs of \$1.0 billion and \$2.6 billion for combined sewer overflow initiatives in the Rouge and Detroit river basin communities, respectively.

Michigan is currently investigating the possibility of using market-based pollutant trading concepts to optimize overall water quality while minimizing costs. Through the implementation of effluent trading, the state expects to improve water quality, minimize costs, form partnerships, and provide greater flexibility in attaining water quality objectives.

New Hampshire

The cost information New Hampshire presented in its 305(b) report is mostly gathered from ongoing public pollution control projects that have received state and/or federal financial assistance. The state estimates total spending for wastewater treatment works through the Federal Construction Grants program of \$838 million (Figure 9-1). Through the State Revolving Fund program, New

Hampshire was able to provide loans to municipalities totaling over \$153 million from FY 1989 through FY 1997. In addition, the Governor of New Hampshire and supporting Legislature enacted Chapter 277 of the Laws of 1992 to provide a new 20% to 30% state grant program for local water pollution control projects. This law directs the state Department of Environmental Services to maintain a priority list of projects eligible to receive these funds. The current priority list includes 99 projects with a total cost of over \$96 million for FY 1998 and 23 projects with a total cost of nearly \$29 million in FY 1999.

New Hampshire noted that all types of water pollution abatement projects benefit the quality of the state's water by reducing the loading of pollutants into the surface waters. However, the state had difficulties in trying to quantify the social and economic benefits of these projects.

North Dakota

The costs associated with municipal point source pollution control programs in North Dakota have been quite significant. Most of these expenditures have been in the area of capital investments. In 1996 and 1997, approximately \$42.9 million from the State Revolving Fund was used for the construction of wastewater system improvements. In addition to SRF funding, several communities have upgraded their wastewater treatment facilities at their own expense.

North Dakota did not quantify monetary benefits of water quality expenditures in their 305(b) report. The state notes that qualitative benefits include the elimination and

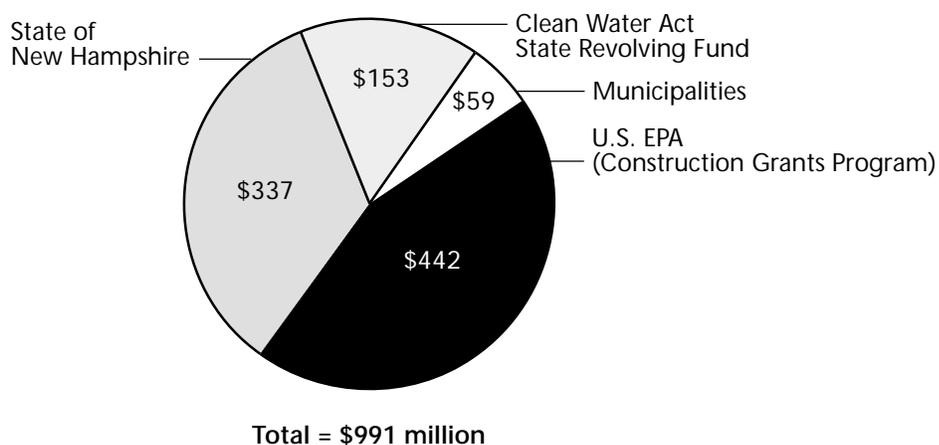
reduction of waste loads to receiving waters and the reduction of stressors to public health, such as malfunctioning drainfield systems and sewer backups.

Oregon

A 1997 report provides estimates of the costs and benefits of water quality improvements in Oregon's Willamette Valley. At one time, the Willamette River was one of the most polluted waterways in Oregon, but since the 1960s this basin has experienced significant water quality improvements. Most of the pollution was coming from municipal and industrial dischargers, although nonpoint sources also played an important role. The report estimated that between \$215 million and \$282 million (1995 dollars) have been spent annually on water pollution control costs in the basin since the 1960s.

Figure 9-1

Costs Incurred in Wastewater Treatment Works in New Hampshire (\$ millions) 1972 - 1997



The qualitative benefits of water improvements in the Willamette Basin include increased participation in water-related recreational activities, improved services and aesthetic values, and reductions in water treatment costs and human health risks, among others. The quantifiable benefits range from \$146 million to \$318 million. The state reports that a cost-benefit analysis would be difficult to perform at this point since not all the benefits have been quantified. However, the report suggests that, overall, the annual benefits of improved water quality in the Willamette Valley may exceed water pollution abatement costs.

Puerto Rico

The Puerto Rico Environmental Quality Board is in charge of management of water pollution control activities, which is carried out using a combination of federal and state funds. Table 9-5 summarizes Puerto Rico's estimated costs to improve water quality.

Destination	Year	Amount	Source
Water Pollution Control	1996	\$2,242	Federal
		\$1,733	State
	1997	\$2,395	Federal
		\$2,255	State
47 Municipal Treatment Works	1989 to 1995	\$129,364	Federal
		\$25,873	State
10 Municipal Treatment Works	1996 to 1997	\$24,425	Federal
		\$6,885	State
Construction Grants	1997 to 2001	\$3,766,349	SRF Program

Rhode Island

Rhode Island's 305(b) report indicates that the state has spent or allocated an estimated \$351 million from 1972 to 1977 in the improvement of the quality of its waters. Most of these funds came from EPA through federal Construction Grants Program funds. The money was allocated among the following projects:

- Six projects involved the construction of new treatment facilities and sewer systems
- Three projects included new wastewater treatment facilities (WWTFs) and installation of sewers
- Seven projects were directed to upgrading an existing primary facility to a secondary treatment plant, as required by the Clean Water Act
- Five projects involved specifically sewerage areas not previously sewerage and discharging to an existing WWTF
- Five projects dedicated to upgrading existing secondary WWTFs to larger, more modern facilities.

Rhode Island notes that the environmental and economic benefits derived from the investment in these projects are significant. The state reports an improvement of the water quality in the shellfish growing areas and in the finishing industries, which combined are a \$25 million industry. These activities also support the \$2 billion a year tourism industry.

South Dakota

The state of South Dakota has placed a high priority on getting all state wastewater treatment facilities into compliance as soon as possible. The state has several "minor" facilities in need of upgrading. Many of the small communities served by these "minor" facilities are agriculturally oriented and financially strapped. The state works along with the communities to leverage additional grant funds. To improve the quality of the state's waters, the state has secured approximately \$2.5 million per year from its Consolidated Water Facility Construction Program (CWFCP).

Utah

Since 1972, approximately 190 wastewater projects have been funded in Utah, with funding received from either EPA Construction Grants, the Utah Water Quality Project Assistance Program (WQPAP), State Revolving Funds (SRF), or the Utah Hardship Grant Program. Table 9-6 lists the assistance that was given for five time

frames. The majority of the state's projects have been for the planning, design, and construction of wastewater collection and treatment facilities in communities.

The construction of centralized wastewater collection and treatment facilities provides water quality protection for surface and ground waters. Currently in Utah, very few large communities remain on septic tank/drainfield systems. Besides these direct benefits of investing in cleaner waters, the state's report mentions:

- Better public education and awareness about the need for water quality and environmental protection
- Pollution prevention of water quality degradation
- Better protection of fisheries in discharge receiving streams
- State legislators' awareness on the need of funding these projects
- Protection of human health

Table 9-6. Funding Expenditures and Project Costs for Wastewater Projects in Utah (\$ thousands)

Time Period	EPA Construction Grants	WQPAP			SRF		
		Project Costs	WQPAP Assistance	Assistance Received (%)	Project Costs	SRF Assistance	Assistance Received (%)
1993 to 1995	\$838	\$21,308	\$11,373	53	\$73,990	\$49,982	68
1985 to 1995	\$14,662	\$133,777	\$36,653	27	\$120,942	\$83,909	69
1972 to 1995	\$207,081	\$165,198	\$47,122	29	\$120,942	\$83,909	69
1996 to 1998	\$0	\$55,791	\$6,107	11	\$54,075	\$29,916	55
1972 to 1998	\$207,081	\$220,989	\$53,229	24	\$175,016	\$113,825	65

- Optimal reuse of biosolids resulting from wastewater treatment
- Community participation in oversight of wastewater treatment facility operations.

Vermont

Vermont spent approximately \$468 million of state, federal, and local funds through 1997 to construct municipal wastewater treatment facilities and industrial wastewater treatment systems. Approximately \$69 million per year is spent on the operation and maintenance of treatment plants in the state. Costs of assisting planning and implementation of nonpoint source pollution reductions total approximately \$460,000.

Improved water quality in Vermont has meant less weed and algae growth, which resulted in improved aesthetics and enhanced swimming, fishing, and boating uses. The state assumes that human health is improved due to the removal of pathogens from water. Approximately 58 rivers and 3 lakes have benefited from these improvements. Vermont's report also mentions significant improvements in the Upper White River, where 4,525 feet of shoreline were stabilized and enhanced. Improvements were also noted from the denial of

hydroelectric facility certifications in five cases. As a result of these habitat improvements, a total of 22.5 miles of Vermont rivers and approximately 3,600 acres of lakes have been improved significantly.

Virginia

Since 1988, Virginia has administered a State Revolving Loan Program, offering loans to local governments at or below current market interest rates for wastewater treatment improvements. Between FY 1988 and FY 1997, Virginia has received federal capitalization grants totaling \$358 million and has provided \$72 million to the program.

In the state's 305(b) report, the following benefits are attributed to Virginia's loan program expenditures:

- Eliminated 12 wastewater treatment plants that provided only primary treatment
- Replaced/upgraded 25 inadequate lagoons
- Upgraded/expanded/replaced 80 outdated treatment facilities
- Improved water quality at 38 locations by reducing infiltration and inflow

- Corrected 21 potential health hazard situations due to the elimination of septic systems, pit privies, and straight-line discharges
- Eliminated 96 raw sewage overflow points.

Wyoming

Table 9-7 summarizes funds dedicated to water quality improvements in Wyoming. The state's 305(b) report notes that water suppliers in Wyoming are generally small and face more challenges as a result of complying with mandated water system improvements. This results in extremely high costs for drinking water in rural areas.

Although Wyoming could not quantify the value of water used for agricultural purposes, the state provided an estimate of the amount of land and livestock supported by water resources. In 1998, Wyoming's water resources were used to rear 1,530,000 cattle and calves and 680,000 sheep and lambs. The state also reported a total of 1,426,897 acres of irrigated agricultural land in the state, valued at an average of \$45.51 per acre. Wyoming estimates that nonirrigated cropland is valued at 32% of the value of irrigated cropland.

Wyoming's 305(b) report included information from a National Recreation Lakes Study

Commission estimate of the economic impact of federal man-made lakes in Wyoming. The estimate is based on visitor days for specific activities. The Commission found that these lakes bring \$436 million and 6,300 jobs to the Wyoming economy. The data from this study are summarized in Table 9-8.

Table 9-7. Federal and State Funding for Improvement of Water Quality in Wyoming (\$ thousands)

Year	Federal Funding	State Funding
1995 to 1996	\$5,353	\$3,594
1997 to 1998	\$5,089	\$3,868
1999 to 2000 ^a	\$5,026	\$4,615

^aAuthorized budget.

Table 9-8. Benefits Derived from Man-Made Lakes of Greater than 1,000 Acre-Feet in Wyoming

Activity	Visitor Days	Total Economic Impact (\$ millions)	Total Employment (Jobs)
Fishing	1,215,000	\$230	3,300
Boating	626,000	\$118	1,700
Swimming	295,000	\$12	200
Camping	700,000	\$29	400
Wildlife Observation	405,000	\$28	400
Other Land Based Recreation	442,000	\$19	300
Total	3,683,000	\$436	6,300